Fort Peck Pallid Sturgeon Study

by

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ABSTRACT

The 1991 field season was the third year of the Fort Peck Pallid Sturgeon Study. Three pallids were captured during SCUBA surveys in the Fort Peck tailrace in January and February, 1991. Two of these were 'new' fish, the other had returned to Fort Peck for at least the third consecutive winter. A radio transmitter was attached to the returning pallid, but the fish was never relocated. The other two fish were tagged with PIT and dangler tags. One of these fish was recaptured by a USFWS crew near Williston, North Dakota, in September, 1991. Two other new pallids were captured and mounted with transmitters near the Missouri/Yellowstone Confluence, one in May, the other in October.

Shovelnose sturgeon were used as surrogates for testing the feasibility of implanting radio transmitters to track sturgeon. Fifteen shovelnose were implanted with transmitters throughout the study area (Missouri River from Fort Peck to Williston and Yellowstone River from Intake to mouth). Personnel from the USFWS and South Dakota Game and Fish provided preliminary direction and field assistance for the procedures. Results have been positive, and implants appear to be a feasible method of tracking sturgeon.

DISCLAIMER

Mention of commercial products in this report does not imply endorsement by the Montana Department of Fish, Wildlife, and Parks.

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INTRODUCTION

This report summarizes the third field season of work on the Fort Peck Pallid Sturgeon Study. The study was begun on April 1, 1989, with a contract between the U.S. Army Corps of Engineers (Corps) and the Montana Department of Fish, Wildlife, and Parks (MDFWP). Clancey (1990, 1991a) report the findings of the first two years of this study.

MDFWP is conducting two other pallid sturgeon studies in addition to the Fort Peck Pallid Sturgeon Study, one on the Missouri River between Fort Peck Reservoir and Fort Benton (Gardner 1990), and one on the Yellowstone River between Intake Diversion Dam near Glendive and Cartersville Diversion Dam near Forsyth (Watson and Stewart 1991). The U.S. Bureau of Reclamation is providing funding for the Yellowstone River pallid sturgeon study.

STUDY AREA

The study area is the Missouri River downstream of Fort Peck Dam to Lake Sakakawea in North Dakota, and the Yellowstone River from its mouth to Intake diversion dam near Glendive, Montana (Figure 1). Discharge of the Missouri River is regulated below Fort Peck Dam, and though the river is significantly altered morphologically from its natural condition, it is relatively unaltered when compared to the impounded and channelized Missouri River downstream of Montana. The hydrograph (Figure 2) and some water quality characteristics, specifically turbidity and temperature, are significantly altered from natural conditions. Accelerated streambank erosion and channel downcutting occur due to the fluctuating water levels in the river and to the "clean, hungry" hypolimnial water releases from Fort Peck Reservoir.

The Yellowstone River is unimpeded for its entire course, except for run-of-the-river irrigation dams. It exhibits a natural hydrograph and water quality characteristics.

METHODS

Field methods were similar to previous years (Clancey 1990, 1991a). Some additional techniques were employed to improve the success of tracking sturgeon. Figure 3 illustrates the meristic and morphological measurements taken on all pallid sturgeon and on most shovelnose caught during the field season. Two additional measurements were taken in 1991- tip-of-the-snout to mouth, and tip-of-the-snout to a line between the base of the middle-barbels (Figure 3).

In late July, Jim Riis of the South Dakota Game and Fish Department and Lynn Kaeding of the U.S. Fish and Wildlife Service came to Fort Peck to provide expertise on the methods they have

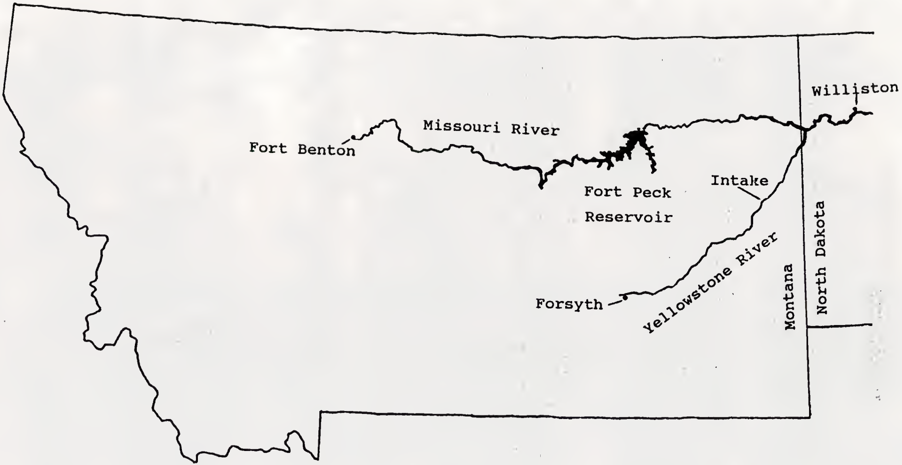

Figure 1. Map of MDFWP pallid sturgeon study areas.

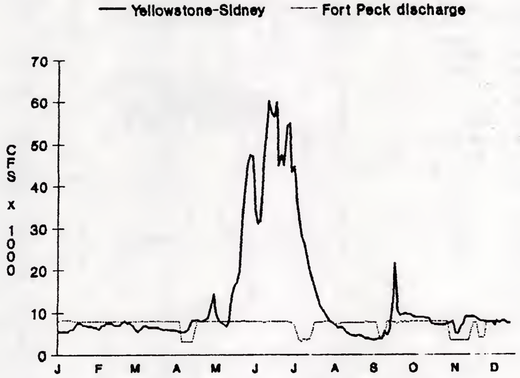

Figure 2. Hydrographs of the Missouri River below Fort Peck Dam and the unaltered Yellowstone River at Sidney.

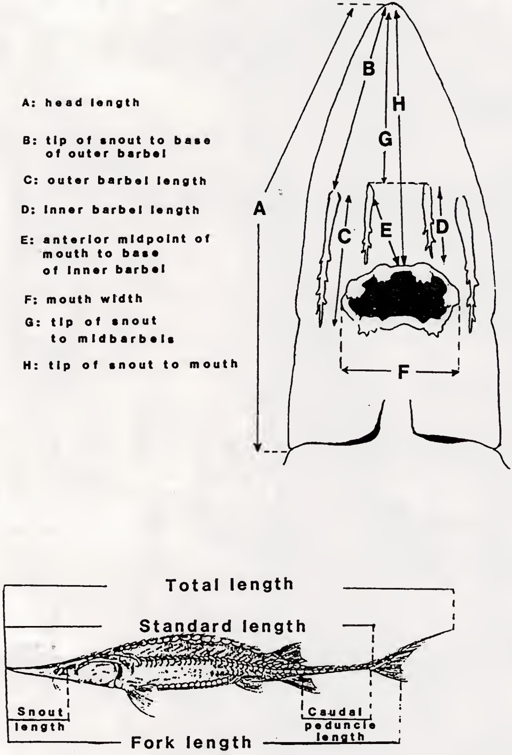

Figure 3. Morphological measurements taken from pallid and shovelnose sturgeon.

used to implant sonic and radio tags, respectively, in fish. Shovelnose sturgeon were used as surrogates for pallids to test the implanting methods. Ross and Kleiner (1982) developed the shielded-needle technique for implanting radio transmitters with external whip antennae, but we decided to use a catheter to feed the antenna of the radio telemetry transmitter through the body of the sturgeon. To accomplish this, two incisions were made in the ventrolateral body wall of the fish- a primary incision about midway on the body, and a secondary incision just anterior to the pelvic girdle (Figure 4). A curve was put in the catheter by running it between the thumb and forefinger. The catheter was then fed anteriorly through the fish's body cavity from the secondary incision before either transmitter was inserted. Once the catheter was in place, we inserted the sonic transmitter in the primary incision and positioned it posterior to that incision. After the sonic transmitter was in place, we fed the antenna of the radio telemetry transmitter into the catheter at the primary incision and continued feeding it posteriorly through the fish. Once the antenna was visibly protruding from the secondary incision (but still in the clear plastic catheter), the catheter was removed from the fish by pulling it posteriorly from the secondary incision. As the catheter was evacuated from the secondary incision, the radio transmitter was simultaneously inserted into the primary incision. As the antenna became exposed with removal of the catheter, it was gently pulled posteriorly to assist the transmitter into the body cavity. The incisions were sutured closed with Ethibond green braided polyester suture swedged into an OS-4 cutting needle. An inverted mattress suture was applied and secured with a series of square knots (Chapman, pers. comm.). About 6"-8" of the antenna was left protruding from the ventral side of the fish. The transmitters and all surgical equipment were soaked in Nolvasan disinfectant, diluted three ounces per gallon of water, prior to implantation. The fish's gills were irrigated with river water during implantation by pumping the water into the fish's mouth using a small bilge pump and surgical tubing.

A general rule of thumb stipulates that the weight of the transmitter in water should not exceed two percent of the fish's body weight. We met this stipulation in all cases. Our intent was to implant both sonic and radio transmitters in each shovelnose, but at Fort Peck, we could do that with only one fish due to the relatively small size of the sturgeon. We implanted three shovelnose with sonic tags only, and three shovelnose with radio tags only.

Shovelnose sturgeon were captured by either overnight sets or drifting of gillnets. Implants were completed in three habitat types within the study area. In the Fort Peck tailrace, the river is up to 45 feet deep, current velocity is relatively slow, bedload movement is minimal, and the channel is free of obstructions. In the Missouri River below the confluence with the Yellowstone, the river is up to 35 feet deep, current velocity is moderate to high, bedload movement is common, and numerous snags and sandbars occur

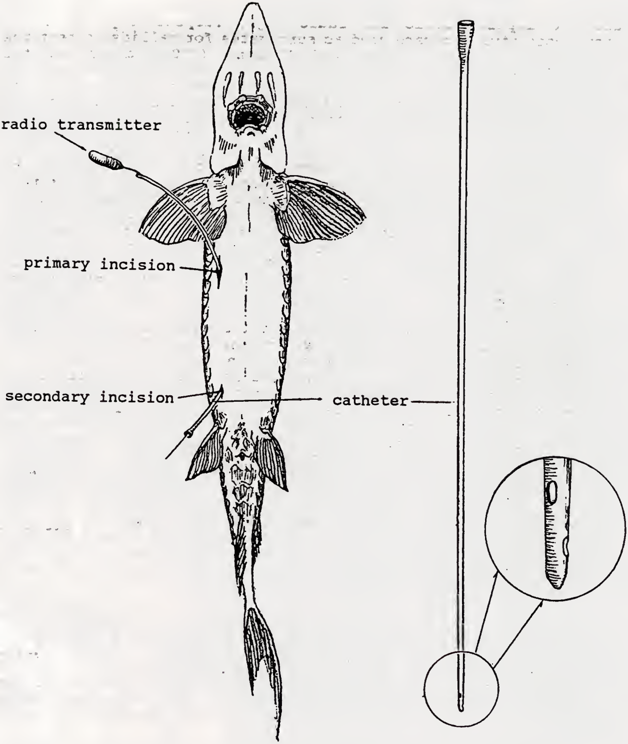

Figure 4. Location of incisions for implanting sonic and radio transmitters in shovelnose sturgeon. Free-hand sketch by Mark Fliger.

throughout the area. Pallid sturgeon are more abundant in this area than anywhere else within the study area. The Yellowstone River downstream of Intake is generally less than 15 feet deep, current velocity is high, bedload movement is common, and sand and gravel bars and islands are abundant.

Two models of radio transmitters were used. They were made by Advanced Telemetry Systems of Isanti, Minnesota. The Model 2 transmitter weighs 11 grams in air, and has an estimated life of 85 days. The Model 5a weighs 45 grams in air and has an estimated life of 275 days. The weight of these transmitters in water is about 45-50 percent of their weight in air (Richard Huempfner, pers. comm.). The effective weights were calculated to be 4.95 grams and 22.5 grams, respectively. The Model 2 can be implanted in a fish that weighs 247.5 grams (0.55 lbs), and the Model 5a can be implanted in a fish that weighs 1125 grams (2.48 lbs).

The sonic transmitters were made by Sonotronics of Tucson, Arizona. Each transmitter weighs 28 grams in air and has an estimated life of 14 months. The weight in water of these transmitters is 8 grams (Don Brumbaugh, pers. comm.), so can be implanted in a fish that weighs 400 grams (0.88 lbs).

Both sonic and telemetry transmitters were implanted in fish only if that fish weighed enough to accommodate both transmitters.

The radio telemetry transmitters are all within the 48.000-48.999 Megahertz (Mhz) range, and each has a unique frequency to allow individual fish to be identified. The sonic transmitters are all in the 74 Kilohertz (Khz) range, but are each uniquely coded to enable identification of individual fish. One of the sonic transmitters is coated with a compound to prevent rejection by the fish, but none of the rest of the sonic transmitters and none of the radio transmitters are similarly coated.

A programmable scanning radio telemetry receiver is used to track sturgeon from an airplane and from a boat. A hydrophone and sonic receiver are also used to track the sturgeon, but this system is restricted to use from a boat.

Pallid sturgeon were mounted with external transmitters as previously described (Clancey 1990).

RESULTS AND DISCUSSION

Pallid sturgeon

Morphological measurements of four 'new' pallid sturgeon captured in the study area in 1991 are shown in Table 1. As in previous years, pallids captured during this study frequently exceed the morphometric ratios calculated by Bailey and Cross (1954) (Table 2).

The winter SCUBA surveys began on January 19 and ended on March 26. Dives occurred almost every weekend between those dates. The two primary divers sighted at least one, and sometimes all three, pallids during each dive at the Park Grove location, which is about 1½ miles below Fort Peck Dam. A total effort of 48 diver-days were spent sighting and capturing pallid sturgeon at two locations in the Fort Peck tailrace. Pallids were sighted only at Park Grove in 1991.

Three pallid sturgeon were captured in the Fort Peck tailrace during SCUBA surveys in January, February, and March. Two of these were new fish, the other was a recapture that had returned to Fort Peck for at least the third successive winter. The returning pallid was outfitted with an external radio transmitter. We had intended to transmit the other two also, but waited too late into March to recapture them. We could get within inches of capturing them, but they would swim away from us just as we were attempting to grip them. We also mounted external transmitters on two new pallid sturgeon captured in the Missouri River below the confluence with the Yellowstone. One of these fish was captured by a USFWS crew on May 31 using an experimental gillnet, the other was captured by us in a 3-inch mesh gillnet on October 10. On September 24, a USFWS crew recaptured the 33 pound pallid that was initially handled at Fort Peck on January 26 during MDFWP SCUBA surveys. It was near the mouth of Little Muddy Creek, east of Williston, North Dakota.

Relocations of externally mounted radio transmitters on pallids were infrequent, so habitat variables were collected from only one relocation. We got no relocations of the pallid tagged at Fort Peck, and only one relocation of those tagged at the Confluence area. We did relocate pallids at the Confluence within 24 hours after mounting the transmitters, but refrained from collecting habitat information at that time to allow the fish time to return to it's normal routine. We do not know if the poor success at relocating is due to the fish's behavior or to malfunctions in the transmitters. An MDFWP fisheries biologist working on the Bitterroot River in western Montana found that two of his five internal transmitters ceased operation when exposed to cold water conditions (Chris Clancy, pers. comm.) The other three are performing satisfactorily. He purchased these transmitters from the same company that provided our external transmitters.

Table 1. Morphological measurements taken from four new pallid sturgeon captured in 1991. Measurements were recorded in the field in tenths of feet then converted to millimeters, percent of standard length is in parentheses, and weight is in pounds. FP= Fort Peck tailrace, ND= Missouri River below the Yellowstone confluence.

	transmitter number			
	---	---	252	151
capture location	FP	FP	ND	ND
capture date	1/26	2/2	5/31	10/10
weight	33	27.5	23	32
total length	1554	1330	1340	1450
fork length	1240	1247	1356	1311
standard length	1158 (100)	1184 (100)	1286 (100)	1277 (100)
head length	391 (33.8)	411 (34.8)	433 (33.6)	402[2] (31.5)
mouth width	101 (8.7)	112 (9.4)	116 (9.0)	98 (7.6)
snout to outer barbel	170 (14.7)	193 (16.3)	198 (15.4)	180 (14.1)
mouth to inner barbel	56 (4.8)	58 (4.9)	49 (3.8)	67 (5.3)
inner barbel[1]	34 (3.0)	46 (3.9)	46 (3.5)	46 (3.6)
outer barbel[1]	116 (10.0)	107 (9.0)	110 (8.4)	110 (8.6)
snout length	213 (18.4)	234 (19.7)	241 (18.7)	198 (15.5)
caudal peduncle length	168 (14.5)	165 (13.9)	168 (13.0)	146 (11.4)
snout to mouth	---	---	222 (17.3)	229 (17.9)
snout to midbarbs	---	---	---	162 (12.7)
girth	503 (43.4)	442 (37.3)	533 (41.5)	518 (40.6)
PIT (7F7F0...)	54864	66471	66A66	65F04
yellow dangler	1347	1319	1361	1370

[1] average of two, or length of the longer of the two
[2] this measurement was recorded in the field as 2.32 feet, but is suspected to have actually been 1.32 feet.

Table 2. Comparison of morphometric characteristics of pallid sturgeon found by Bailey and Cross (1954) and those captured in this study in 1991. See Figure 3 for ratio definitions.

	pallid sturgeon number				
	---	---	252	151	B&C
E in B=	3.04	3.33	4.04	2.69	2.3-3.3
E in F=	1.80	1.93	2.37	1.46	1.6-2.0
E in A=	6.98	7.09	8.84	6.01	5.5-7.0
D in B=	5.00	4.20	4.30	3.91	2.6-3.7
D in C=	3.41	2.33	2.39	2.39	1.6-2.4
D in A=	11.50	8.93	9.41	8.74	6.3-8.0

As in the previous two years, morphological measurements were used to differentiate pallid and shovelnose sturgeon (Table 3). No suspected pallid-shovelnose hybrids were captured.

Reports of angler caught pallid sturgeon were not uncommon in the spring of 1991. Three pallid sturgeon were caught by paddlefish anglers at Intake, and a 10-year old boy caught a 3-4 pound sturgeon at Intake that he identified from photographs as a pallid. In the Missouri River upstream of Fort Peck, five pallids were caught by paddlefish anglers, and another angler reported what he believed was an eight pound pallid just upstream of the reservoir. He used the drawings in the state's fishing regulations to identify the fish.

Efforts to sample for larval sturgeon throughout the study area were thwarted when a piston in the boat engine disintegrated during spring fieldwork. The boat was out of commission for three weeks in July, the same time that larval sturgeon have been captured above Fort Peck Reservoir in other studies (Berg 1981, Clancey 1991b, 1991c).

Shovelnose sturgeon

Catch-per-unit-effort for shovelnose sturgeon during the 1991 field season varied seasonally, by river section, and by net type (Appendix Table 1). Generally, shovelnose were most abundant in the Fort Peck tailrace, in the Yellowstone River, and in the Missouri River below the confluence with the Yellowstone. Shovelnose in the Fort Peck tailrace appear to be smaller, in general, than shovelnose in the Yellowstone and at the Confluence.

Shovelnose sturgeon were very abundant at Intake in the spring of 1991, presumably due to the unusually high runoff in

Table 3. Average percent of standard length of selected morphological characteristics of pallid and shovelnose sturgeon. Measurements from pallid sturgeon captured in 1989, 1990 and 1991 were pooled to calculate the figures in this table. Only "new" fish are included in this table.

		shovelnose					
		Missouri			Yellowstone		
	pallids	1991 (n=81)	1990 (n=34)	1989 (n=54)	1991 (n=56)	1990 (n=40)	1989 (n=22)
head length	33.5 (n=12)	29.8	28.9	29.1	28.8	29.2	29.4
snout length	18.1 (n=10)	15.6	15.6	15.2	15.3	16.0	15.7
mouth width	8.8 (n=11)	6.7	7.6	8.4	7.2	7.5	8.1
snout to outer barbels	14.9 (n=10)	9.8	9.3	9.7	9.5	9.5	10.5
mouth to inner barbels	4.4 (n=10)	6.7	6.7	6.8	6.4	6.3	6.5
inner barbels	3.4 (n=12)	6.2	6.2	5.9	6.1	6.4	6.5
outer barbels	9.5 (n=12)	8.9	8.4	8.0	8.7	8.6	8.9
caudal peduncle	12.7 (n=10)	16.9	16.0	16.0	15.9	14.8	15.3
girth (at widest)	41.3 (n=10)	33.0 (n=40)	30.2	34.6	33.9 (n=40)	33.9	36.3
snout to anterior midmouth	17.7 (n=2)	15.4	---	---	15.9	---	---
snout to midbarb	12.7 (n=1)	9.2 (n=70)	---	---	9.1	---	---

the Yellowstone River, and were frequently snagged by paddlefish anglers. Dennis Scarnecchia (pers. comm.) estimates that 3000-4000 shovelnose were incidentally caught at Intake in 1991. The Bureau of Reclamation, which developed and maintain the Intake irrigation system, is attempting to provide funding for a technician to inspect as many shovelnose as possible in 1992, both at Intake and above Fort Peck Reservoir, to determine if any are actually small pallids.

The test implants of radio and sonic transmitters in shovelnose sturgeon has been very successful to this point. Three shovelnose were implanted in the Missouri River downstream of the mouth of the Yellowstone, one was implanted in the Yellowstone about five miles above the mouth, and four were implanted about two miles below Intake Diversion Dam. All of these shovelnose are females. A total of seven shovelnose were implanted in the Fort Peck tailrace, but the sex of these fish was not noted or was not discernible (Table 4). Though we have not yet recaptured any of the fish to examine them, there have been no apparent ill effects of implanting the transmitters. We do not believe that any of the transmitters were rejected by the fish. We detected significant movements by all the fish implanted, though some of those movements were local in nature. All fish implanted in the Fort Peck tailrace remained in that vicinity, but most of those implanted at Intake and in the Confluence area exhibited relatively extensive movement (Appendix Figure 1).

The greatest movement was by a fish implanted at Intake. It moved approximately 60 river miles downstream to the vicinity of the Highway 200 bridge just east of Fairview, Montana. All three of the fish implanted in the Missouri near the confluence have moved upstream into the Yellowstone.

Habitat use information for relocations of implanted shovelnose is shown in Appendix Table 2.

Appendix Table 3 lists empirical measurements and corresponding percent of standard length for shovelnose sturgeon captured in the Missouri and Yellowstone rivers.

Related activities

Throughout the year, MDFWP publicized the pallid sturgeon situation by several methods. A short newsspot was produced for the statewide television news and two articles were published in Montana Outdoors, the Department magazine. Additionally, MDFWP personnel participated in Project WILD workshops, posters that use actual color photographs to illustrate the differences between pallids and shovelnose are displayed at fishing access sights and popular fishing locations, and a full page in the fishing regulations is dedicated to explain the differences between pallids and shovelnose.

The Montana Co-operative Fisheries Research Unit at Montana State University in Bozeman has secured funding to provide a graduate student to assist with pallid sturgeon research.

Table 4. Statistics of fifteen shovelnose sturgeon implanted with radio and/or sonic transmitters in the Missouri and Yellowstone rivers. Lengths are in millimeters, weights in grams. Transmitter weights are weight-in-water.

date/location	radio freq./ sonic code	fish length	fish weight	transmitter weight(s)	percent[1]	disk tag #s
7/30/91						
Fort Peck tailrace	48.700/248	742	1725	12.95	.75	669, 670
	48.720/	602	681	4.95	.73	667, 668
	/3335	640	771	8	1.03	671, 672
7/31/91						
Fort Peck tailrace	48.780/	--	1135	4.95	.44	681, 682
	48.800/	--	--	4.95	--	673, 679
	/257	--	681	8	1.17	683, 684
	/338	--	953	8	.84	574, 680
8/6/91						
Intake, Yellowstone	48.560/22324[2]	869	2906	30.5	1.05	687, 688
	48.600/2525	919	3087	30.5	.99	685, 686
8/7/91						
Intake, Yellowstone	48.620/2236	927	3405	30.5	.90	690, 691
	48.640/3342	914	3087	30.5	.99	689, 692
8/8/91						
Missouri confluence	48.680/22234	917	3087	30.5	.99	693, 694
	48.740/3333	856	1771	12.95	.73	---, ---
9/4/91						
Missouri confluence	48.760/23233	940	2633	12.95	.49	697, 698
10/9/91						
Fairview, Yellowst.	48.660/2442	919	--	30.5	--	741, 742

[1] percent of fish's body weight ((transmitter weight-in-water/body weight of fish) * 100)
[2] radio transmitter 48.560 was emitting an unusual signal, and was lost shortly after deployment.

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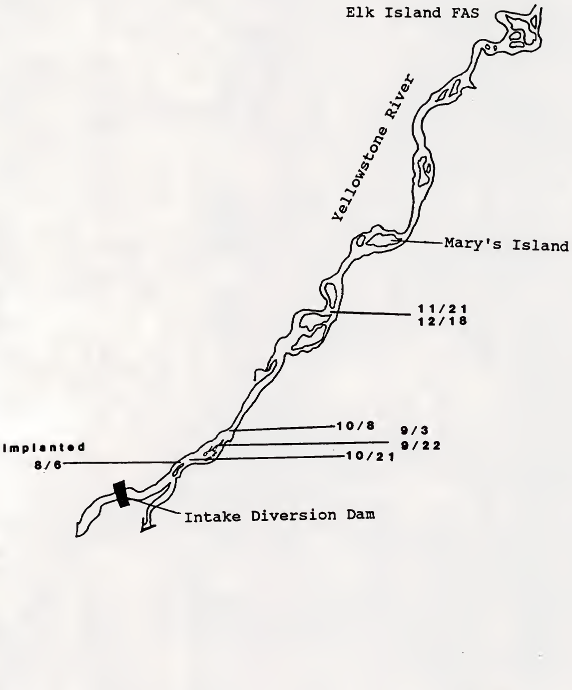
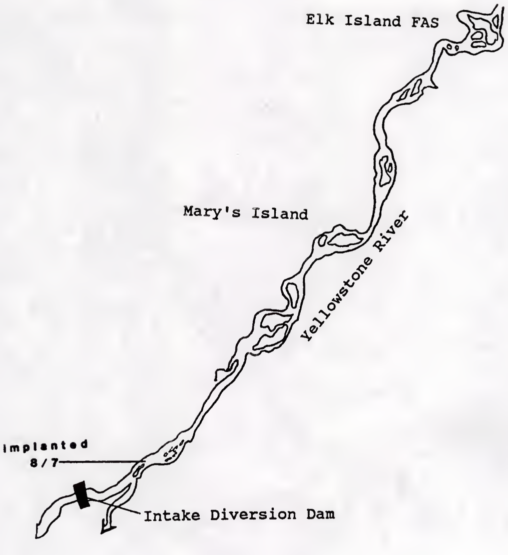
Appendix Figure 1. Movement maps for each implanted shovelnose sturgeon in the Yellowstone River and Confluence area. Each fish is identified by radio transmitter number, which is in the lower right hand corner of each page.


Elk Island FAS
Yellowstone River
Mary's Island
11/21
12/18
10/8
9/3
9/22
10/21
Implanted
8/6
Intake Diversion Dam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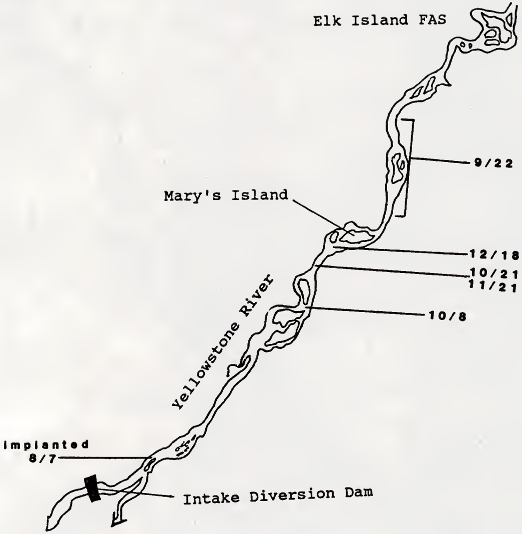
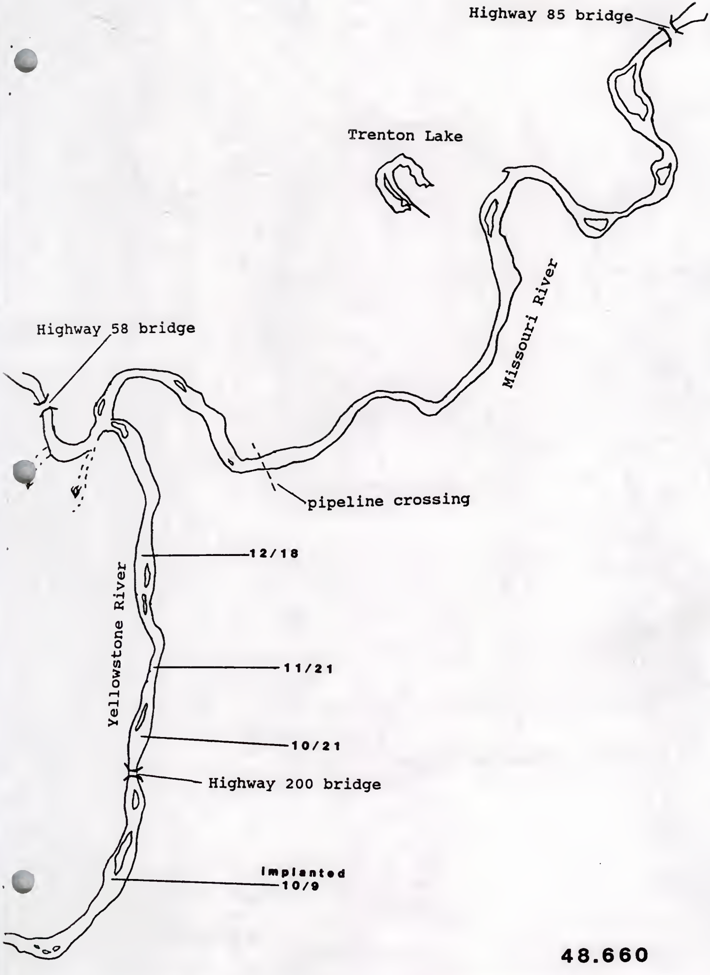
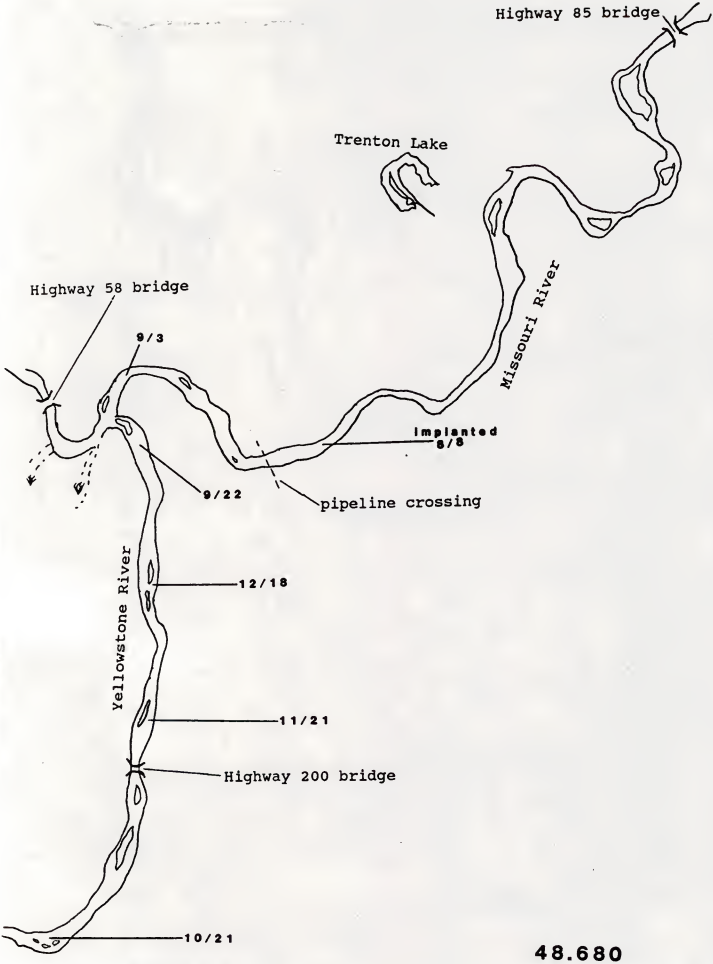
Mary's Island
Yellowstone River
Implanted
8/7
Intake Diversion Dam



Elk Island FAS
9/22
Mary's Island
12/18
10/21
11/21
10/8
Yellowstone River
Implanted
8/7
Intake Diversion Dam


Highway 85 bridge
Trenton Lake
Missouri River
Highway 58 bridge
pipeline crossing
12/18
Yellowstone River
11/21
10/21
Highway 200 bridge
Implanted
10/9

48.660


Highway 85 bridge
Trenton Lake
Missouri River
Highway 58 bridge
9/3
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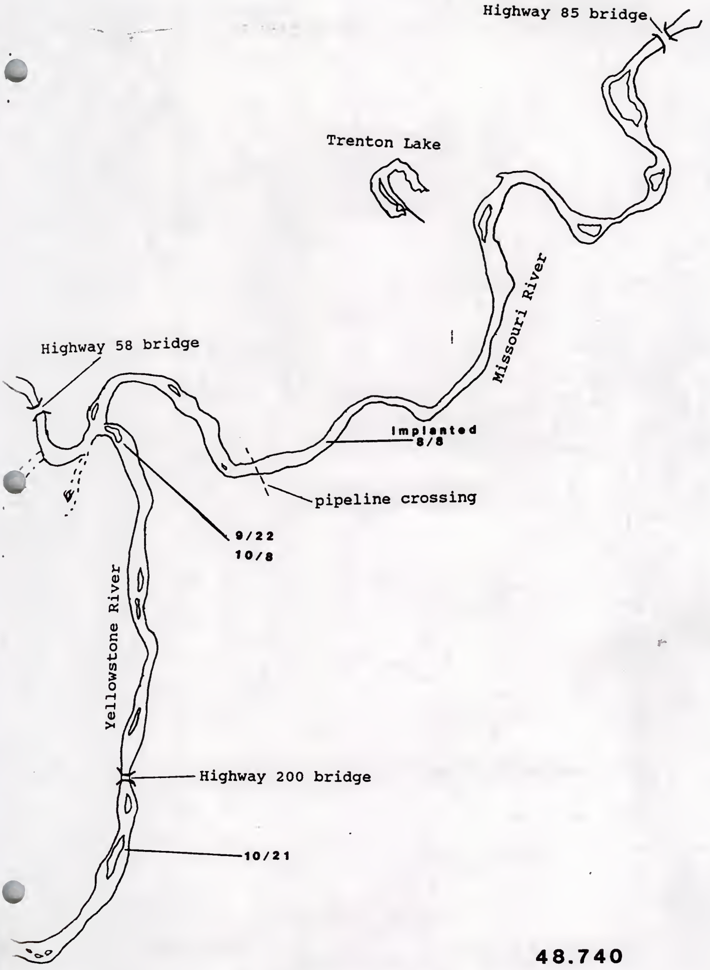
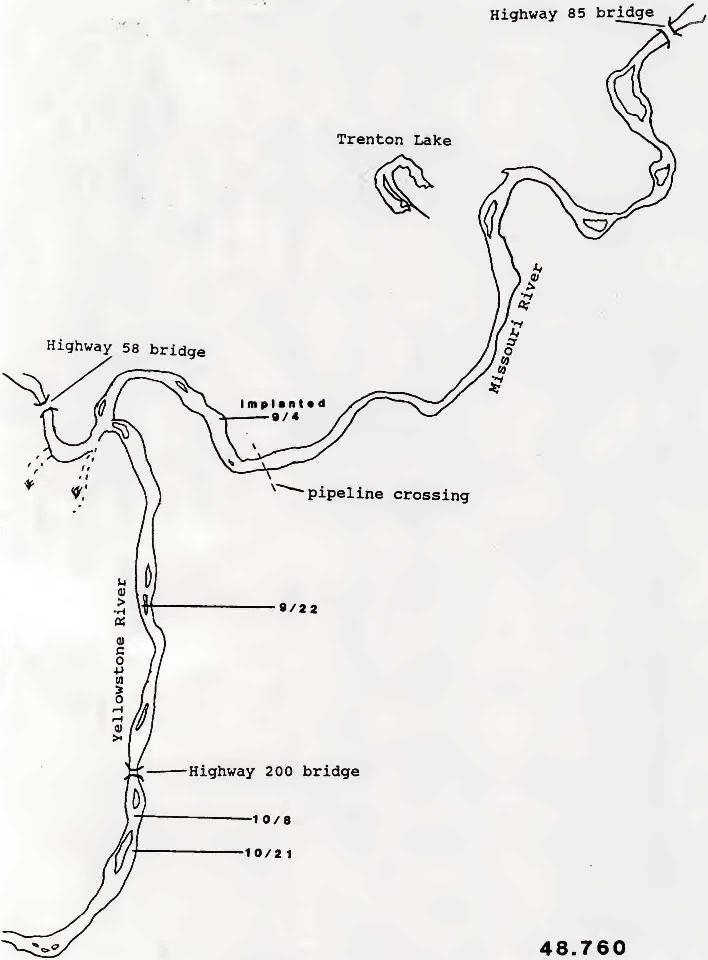
8/8
9/22
pipeline crossing
Yellowstone River
12/18
11/21
Highway 200 bridge
10/21

48.680


Highway 85 bridge
Trenton Lake
Missouri River
Highway 58 bridge
Implanted
8/8
pipeline crossing
9/22
10/8
Yellowstone River
Highway 200 bridge
10/21

48.740


Highway 85 bridge
Trenton Lake
Missouri River
Highway 58 bridge
Implanted
9/4
pipeline crossing
Yellowstone River
9/22
Highway 200 bridge
10/8
10/21

48.760

Appendix Table 1. Catch-per-unit-effort during 1991 for shovelnose sturgeon by season, river section, and net type.

Season	Net type[1]	River section[2]	#sns	hours	CPUE
Spring (Apr-Jun)	exp.	1	16	1.92	8.3
		4	8	3.00	2.7
		5	4	1.53	2.6
		6	1	1.78	1.6
	3-inch	1	0	0.20	000
		4	0	1.73	000
		5	0	3.35	000
		6	0	2.47	000
Summer (Jul-Sep)	exp.	1	5	1.12	4.5
		2	3	2.07	1.4
		6	26	3.60	7.2
		9	2	1.20	1.7
	3-inch	6	7	0.92	7.6
		8	43	0.67	64.2
Fall (Oct-Nov)	exp.	2	3	2.18	1.4
		6	28	2.27	12.3
		8	14	0.53	26.4
	3-inch	6	16	1.38	11.6

[1] standard experimental gillnet or 3-inch mesh gillnet
[2] river sections were subjectively defined as follows:

1 Fort Peck Dam to the mouth of the Milk River
2 Milk River to Wolf Point (filtration plant)
3 Wolf Point to mouth of Redwater River
4 mouth of the Redwater River to the mouth of Big Muddy Creek
5 Big Muddy Creek to the confluence of the Missouri and Yellowstone rivers
6 Missouri/Yellowstone confluence to Highway 85 Bridge
7 Highway 85 Bridge to Lake Sakakawea
8 Yellowstone River from Intake to Highway 200 Bridge
9 Yellowstone River from Highway 200 Bridge to the Missouri/Yellowstone confluence

Appendix Table 3. Empirical measurements and percent of standard length of morphological characters of shovelnose sturgeon captured in the Missouri and Yellowstone rivers in 1991. Lengths are in inches. Definitions of abbreviations precede the table, and some are illustrated in Figure 3.

TL- total length
FL- fork length
SL- standard length
HL- head length (distance from tip of snout to posterior edge of gill opening)
MW- mouth width
SNTO- distance from tip of snout to base of outer barbels.
MTHI- distance from anterior midpoint of mouth to base of inner barbels.
SNTLE- distance from tip of snout to anterior edge of eye.
CAUD- distance from posterior base of anal fin to anterior base of caudal fin.
GIRTH- girth at the widest point of the body (usually just behind the pectoral fins)
INBR- average length of the two inner barbels
OUTB- average length of the two outer barbels
SNTM- straight-line distance from tip of snout to anterior midpoint of mouth
SNTB- straight-line distance from tip of snout to a point midway between the base of the ineer barbels

Missouri River
empirical measurements

row	TLIN	FL	SL	HL	SNTLE	MW	SNTO	MTHI	INBR	OUTB	CAUD	GIRTH	SNTM	SNTB
1	28.7	26.2	24.3	6.7	3.7	2.4	2.4	1.3	1.5	2.0	4.5	6.8	3.6	0.0
2	28.7	26.3	24.4	7.2	3.7	2.4	2.4	1.5	1.4	1.9	3.8	7.3	3.7	0.0
3	26.2	24.7	22.9	6.3	3.3	1.2	2.0	1.3	1.4	1.8	3.6	7.2	3.3	0.0
4	17.7	13.0	11.9	3.4	2.0	1.2	1.3	0.7	0.8	0.9	2.5	4.2	1.9	0.0
5	20.3	16.4	15.1	4.2	2.2	1.2	1.3	0.8	1.0	1.2	3.2	5.0	2.1	0.0
6	29.0	27.2	25.3	7.2	3.8	2.4	2.2	1.6	1.4	2.1	4.3	8.5	3.8	0.0
7	32.0	29.4	27.5	7.9	4.4	2.4	2.5	1.8	1.8	2.4	3.8	9.6	4.2	0.0
8	24.0	22.0	20.4	5.8	3.1	1.2	1.9	1.2	1.9	1.9	3.3	5.8	3.1	0.0
9	22.2	15.5	14.1	3.7	2.0	1.2	1.4	0.9	0.8	1.2	2.8	4.5	2.4	0.0
10	31.7	29.4	27.3	9.3	4.4	2.4	2.5	1.8	1.8	2.4	4.2	9.4	4.4	0.0
11	26.7	24.5	22.7	6.8	3.7	1.2	2.4	1.4	1.4	1.9	3.3	8.0	3.6	0.0
12	27.5	25.0	23.3	7.0	3.6	2.4	2.1	1.4	1.4	1.9	4.0	7.8	3.6	2.0
13	26.8	24.9	23.2	7.0	3.6	1.2	2.4	1.4	0.8	1.6	3.3	6.6	3.7	2.1
14	27.7	24.2	22.4	6.3	3.6	1.2	2.2	1.3	1.2	1.9	3.8	7.0	3.3	2.0
15	27.0	25.1	23.5	6.9	3.6	1.2	2.2	1.4	1.3	1.8	3.6	6.8	3.4	2.1
16	27.3	22.7	20.9	6.2	3.3	1.2	2.1	1.3	1.2	1.9	3.8	7.3	3.3	2.0
17	27.2	24.4	22.6	6.6	3.4	1.2	2.0	1.4	1.4	1.9	3.7	7.2	3.3	1.8
18	27.2	22.9	21.1	6.2	3.4	1.2	2.1	1.4	1.4	1.9	3.4	6.6	3.3	1.9
19	26.6	24.0	22.2	6.4	3.6	1.2	2.2	1.4	1.4	1.8	3.8	6.9	3.4	2.1
20	23.4	21.5	20.0	6.0	3.2	1.2	1.9	1.3	1.4	1.8	3.0	6.6	3.0	1.8
21	23.1	21.1	19.5	5.5	3.1	1.2	1.9	1.3	1.2	1.5	3.6	6.8	3.0	1.6
22	24.0	22.9	21.4	6.0	3.2	1.2	1.9	1.3	1.3	1.8	3.6	6.8	3.1	1.8
23	24.5	22.3	20.8	6.0	3.1	1.2	1.9	1.2	1.3	1.8	3.7	6.9	3.1	1.8
24	24.3	21.9	20.3	5.8	3.2	1.2	2.0	1.2	1.2	1.6	3.7	7.2	3.1	1.9
25	29.5	27.0	25.0	7.4	3.8	1.2	2.4	1.4	1.5	2.0	3.9	7.9	3.7	2.1
26	30.1	27.4	25.3	7.6	3.8	1.2	2.5	1.5	1.5	2.1	4.4	8.1	3.6	2.2
27	28.6	25.9	24.1	7.3	3.9	1.2	2.2	1.4	1.6	2.2	3.7	8.1	3.6	2.2
28	29.0	25.8	23.7	6.7	3.6	1.2	2.4	1.3	1.3	1.8	4.2	7.8	3.4	2.1
29	27.0	22.8	20.7	6.0	3.4	1.2	2.2	1.5	1.6	1.9	4.0	6.8	3.2	1.9
30	23.0	20.9	19.1	5.7	3.3	1.2	2.1	1.4	1.1	1.3	3.0	6.7	3.2	1.7
31	24.6	22.3	20.8	5.9	3.3	1.2	1.8	1.3	1.4	1.5	3.8	6.4	3.0	1.6
32	23.2	20.4	18.7	5.4	3.0	1.2	1.8	1.1	0.9	1.5	3.6	6.6	2.8	1.6
33	25.7	22.5	21.0	6.1	3.3	1.2	2.1	1.5	1.3	1.7	3.8	6.5	3.2	1.8
34	27.0	24.6	23.0	6.8	3.8	2.4	2.4	1.4	1.5	2.2	3.8	8.0	3.4	2.1
35	28.8	25.9	24.1	6.9	3.7	1.2	2.2	1.4	1.5	2.0	4.0	8.0	3.4	2.0
36	31.8	28.4	26.8	7.8	4.2	2.4	2.6	1.8	1.6	2.5	4.9	9.2	4.0	2.4
37	23.8	22.2	20.4	6.0	3.2	1.2	2.0	1.3	1.5	2.1	3.7	7.4	3.1	1.6
38	31.3	28.3	26.5	7.9	4.3	2.4	2.6	1.8	1.8	2.2	4.3	9.4	4.0	2.2
39	33.7	29.2	27.4	7.8	4.2	1.2	2.6	1.5	1.8	2.4	4.3	9.4	4.0	2.5
40	36.1	32.9	31.7	9.2	5.2	2.4	3.2	1.9	2.1	2.7	4.6	11.4	5.0	3.0
41	28.3	26.4	23.8	7.1	3.7	1.7	2.4	1.6	1.3	2.0	3.6	0.0	3.8	2.2
42	26.6	24.7	23.1	6.2	3.1	1.4	1.9	1.3	1.3	1.7	4.0	6.8	3.1	1.8
43	28.6	25.4	23.5	6.5	3.2	1.6	2.3	1.4	1.4	2.2	4.2	7.0	3.5	2.2
44	27.2	24.9	23.2	6.6	3.4	1.6	2.3	1.4	1.6	2.2	4.1	7.2	3.5	2.0
45	26.4	24.1	22.4	6.2	3.1	1.3	2.2	1.2	1.3	1.7	3.8	7.2	3.4	1.9
46	37.0	34.5	31.9	9.8	5.1	2.2	3.5	2.2	2.2	2.6	4.8	11.2	5.0	2.9
47	31.1	26.8	24.8	7.9	4.2	2.2	2.6	1.6	1.8	2.3	4.3	8.9	4.1	2.5
48	28.3	22.3	20.7	5.9	3.1	1.2	2.2	1.4	1.3	1.8	3.8	6.7	3.2	1.9
49	25.8	23.6	21.9	6.3	3.3	1.4	2.0	1.3	1.4	2.0	3.4	7.4	3.2	1.8
50	31.5	28.1	26.0	7.8	4.0	1.7	2.6	1.8	1.7	2.3	4.3	8.8	4.0	2.3
51	30.1	26.2	24.2	6.9	3.6	1.4	2.4	1.6	1.4	1.9	4.0	7.7	3.8	2.3
52	29.8	26.7	24.7	7.2	3.6	2.2	2.4	1.6	1.6	2.3	4.3	8.2	3.7	2.2
53	30.0	25.5	23.7	6.5	3.1	1.4	2.2	1.4	1.6	2.2	4.6	4.6	3.5	1.9
54	25.1	22.2	20.4	5.3	2.8	1.2	2.0	1.3	1.3	1.8	4.1	6.1	3.1	1.8
55	17.4	11.3	10.4	2.9	1.6	0.7	1.1	0.6	0.7	1.0	2.4	0.0	1.7	1.0
56	26.8	24.7	22.5	6.3	3.0	1.3	1.9	1.4	1.2	1.7	3.8	0.0	3.2	1.8
57	29.5	26.8	25.0	7.4	3.9	1.6	2.5	1.7	1.6	2.2	4.0	0.0	4.0	2.4

row	TLIN	FL	SL	HL	SNTLE	MW	SNTO	MTHI	INBR	OUTB	CAUD	GIRTH	SNTM	SNTB
58	28.4	25.7	23.9	6.8	3.6	1.4	2.4	1.6	1.4	1.8	3.8	0.0	3.8	2.3
59	24.9	22.6	21.0	6.0	3.1	1.3	2.0	1.4	1.3	1.7	3.8	0.0	3.4	1.9
60	28.5	26.4	24.4	7.3	3.5	1.6	2.3	1.8	1.8	2.5	4.0	0.0	3.8	2.2
61	32.5	28.6	26.6	7.4	3.7	1.7	2.5	1.7	1.8	2.5	4.6	0.0	4.0	2.3
62	34.3	32.7	30.4	8.7	4.5	2.0	3.1	2.2	2.0	2.9	4.4	0.0	4.9	2.8
63	31.5	27.6	25.5	7.4	3.9	1.7	2.8	1.6	1.6	2.4	4.1	0.0	4.2	2.6
64	20.5	18.8	17.3	4.9	2.6	1.1	1.8	1.2	1.2	1.7	3.2	0.0	2.8	1.6
65	33.3	30.4	28.3	8.9	4.5	1.8	3.2	2.3	1.9	2.5	4.4	0.0	4.8	2.8
66	32.7	28.7	26.6	8.6	3.7	1.8	2.4	1.8	1.6	2.2	4.4	0.0	4.0	2.2
67	30.6	26.6	24.7	7.4	3.9	1.7	2.6	1.7	1.6	2.2	4.2	0.0	4.0	2.4
68	27.3	22.3	20.5	5.8	3.1	1.3	2.2	1.3	1.6	1.8	3.5	0.0	3.2	1.9
69	27.1	20.9	19.2	5.7	3.0	1.3	2.0	1.4	1.2	1.4	3.6	0.0	3.1	1.8
70	26.3	25.0	23.2	7.0	3.8	1.6	2.5	1.6	1.4	1.8	3.5	0.0	3.8	2.2
71	27.1	24.1	22.3	6.1	3.0	1.4	2.0	1.6	1.6	2.0	3.8	0.0	3.4	1.7
72	26.3	22.9	21.2	5.8	3.0	1.3	2.0	1.6	1.4	1.8	3.7	0.0	3.2	1.8
73	26.3	23.9	22.1	6.6	3.3	1.4	2.2	1.4	1.3	1.8	4.0	0.0	3.6	2.0
74	21.8	20.2	18.7	5.5	2.7	1.1	1.8	1.3	1.3	1.7	3.1	0.0	3.0	1.7
75	34.4	30.2	28.5	8.8	4.7	2.0	3.0	2.2	1.9	2.6	4.6	0.0	4.9	2.8
76	27.3	24.6	22.6	6.9	3.6	1.4	2.4	1.6	1.6	2.2	3.8	0.0	3.7	2.2
77	34.5	31.6	29.4	9.0	4.6	2.0	3.0	1.9	2.3	3.0	4.4	0.0	4.8	2.9
78	25.1	23.1	21.2	6.4	3.2	1.3	2.2	1.4	1.3	1.8	3.5	0.0	3.4	1.9
79	22.0	20.5	19.0	5.6	2.9	1.2	1.9	1.4	1.3	1.7	3.2	0.0	3.0	1.7
80	20.8	14.8	13.7	4.0	2.2	0.8	1.7	1.0	0.8	1.1	3.1	0.0	2.4	1.4
81	28.1	25.7	23.7	6.8	3.7	1.4	2.4	1.6	1.6	2.2	4.4	0.0	3.7	2.0

Yellowstone River
empirical measurements

row	TLIN	FL	SL	HL	SNTLE	MW	SNTO	MTHI	INBR	OUTB	CAUD	GIRTH	SNTM	SNTB
1	34.5	30.8	28.8	8.1	4.4	2.1	3.0	1.9	2.0	2.7	5.0	10.0	4.5	2.6
2	34.9	31.0	29.0	8.3	4.6	2.1	3.0	1.8	1.5	2.4	4.2	10.2	4.5	2.8
3	33.9	30.7	28.5	8.6	5.0	2.1	2.8	1.9	1.9	2.4	4.2	9.7	4.6	2.6
4	36.0	33.0	30.7	8.8	5.0	2.1	2.8	2.0	2.0	2.5	5.0	10.8	4.5	2.6
5	34.5	30.2	27.9	8.1	4.5	2.2	3.0	1.8	1.9	2.7	4.2	9.9	4.4	2.7
6	28.8	26.2	24.4	7.4	4.2	1.9	2.5	1.7	1.3	1.9	3.3	8.4	3.9	2.4
7	34.3	31.0	28.7	8.4	4.4	2.2	2.6	1.8	2.0	3.2	4.2	10.6	4.5	2.5
8	32.2	28.0	26.1	7.5	4.2	1.9	2.6	1.6	1.4	2.1	4.2	8.8	3.9	2.4
9	34.4	31.3	29.3	8.8	4.8	2.1	2.8	1.9	1.9	2.7	4.6	9.6	4.5	2.7
10	36.2	33.1	30.7	8.4	4.3	2.2	2.6	1.9	2.0	2.6	4.8	10.8	4.4	2.4
11	34.6	31.6	29.5	8.4	4.4	2.2	2.8	1.8	1.8	2.4	4.6	10.3	4.5	2.5
12	34.2	31.0	28.9	8.4	4.6	2.0	2.8	1.8	1.8	2.7	4.3	9.0	4.6	2.8
13	33.1	28.9	26.8	7.8	4.4	2.0	2.7	1.6	1.8	2.5	4.0	9.2	4.3	2.6
14	34.7	30.3	28.2	7.9	4.2	2.0	2.4	1.8	1.6	2.1	4.2	8.8	4.2	2.2
15	30.4	25.9	24.0	6.7	3.8	1.8	2.5	1.4	1.4	1.8	4.2	7.8	3.6	2.2
16	30.9	28.7	26.9	7.8	4.2	2.0	2.7	1.8	1.5	2.2	3.9	10.2	4.2	2.5
17	31.0	26.5	24.8	7.3	4.0	1.8	2.7	1.4	1.6	2.0	3.7	8.1	3.9	2.4
18	32.5	30.0	28.1	7.8	3.9	2.1	2.5	1.6	1.6	2.4	4.3	9.9	3.9	2.2
19	33.0	30.6	28.9	9.1	5.2	2.4	3.4	1.9	1.8	2.2	4.0	10.3	5.1	3.3
20	32.7	27.8	25.8	7.5	3.9	2.0	2.6	1.5	1.5	2.4	4.0	9.2	3.8	2.2
21	32.1	28.7	27.1	8.1	4.3	2.1	2.7	1.6	1.6	2.2	4.5	9.4	4.2	2.0
22	29.8	26.0	24.2	6.6	3.6	1.5	2.2	1.3	1.4	1.9	4.4	8.1	3.4	2.0
23	30.8	28.2	26.6	7.6	4.0	1.8	2.5	1.6	1.5	2.1	3.8	9.2	3.8	2.2
24	30.5	25.8	24.1	6.9	3.8	1.6	2.4	1.3	1.5	1.9	4.2	7.5	3.7	2.4
25	28.8	26.3	24.5	7.2	3.9	1.9	2.4	1.4	1.4	2.0	3.8	8.4	3.7	2.4
26	31.9	27.3	25.7	7.9	4.4	2.0	2.7	1.5	1.5	2.1	3.7	9.3	4.2	2.6
27	36.5	33.5	31.2	9.3	4.8	2.6	3.0	1.9	2.1	2.5	4.5	11.5	4.9	3.0
28	32.5	28.1	26.3	6.8	3.6	1.9	2.4	1.5	1.9	2.2	4.5	8.6	3.8	2.2
29	35.3	32.9	30.5	8.7	4.5	2.6	2.6	1.6	1.6	2.4	4.4	11.4	4.5	2.4
30	28.2	25.1	23.6	6.3	3.8	2.0	2.4	1.5	1.4	1.8	3.4	7.4	3.8	2.4
31	35.9	33.5	31.5	9.0	4.6	2.4	3.0	2.0	2.0	2.7	4.2	10.2	4.6	2.6
32	36.0	32.6	30.4	8.4	4.9	2.6	2.7	2.1	2.0	2.7	4.6	10.5	4.5	2.4
33	32.8	28.5	26.9	7.6	4.3	2.1	2.6	1.8	1.5	2.2	3.9	9.1	4.2	2.7
34	20.3	16.3	15.1	3.9	2.2	0.9	1.4	0.9	0.8	1.2	2.7	4.3	2.1	1.3
35	35.5	32.0	30.2	8.7	5.0	2.5	3.0	1.9	1.9	2.6	4.6	9.6	4.9	3.0
36	30.3	28.2	26.8	7.4	3.8	2.2	2.2	1.5	1.4	2.4	3.7	8.8	3.8	2.0
37	27.2	25.9	24.5	7.3	3.9	2.1	2.4	1.8	1.5	2.1	3.6	8.4	4.2	2.4
38	33.6	30.5	28.4	7.9	4.2	2.2	2.4	1.9	1.8	2.5	4.8	8.8	4.2	2.2
39	36.4	33.4	31.2	8.7	4.6	2.5	2.7	2.0	2.1	3.0	5.0	10.2	4.8	2.6
40	35.7	33.0	30.9	9.1	4.6	2.8	2.8	2.1	2.0	2.7	4.4	10.6	4.5	2.5
41	34.9	30.4	28.3	8.1	4.2	1.8	3.0	1.9	1.9	2.5	4.8	0.0	4.7	2.6
42	25.6	23.2	21.5	5.9	2.9	1.3	1.9	1.4	1.3	1.7	3.7	0.0	3.1	1.8
43	31.0	26.9	24.9	6.7	3.6	1.4	2.4	1.7	1.6	1.9	4.8	0.0	3.7	2.2
44	27.5	23.2	21.4	6.2	3.2	1.3	2.2	1.4	1.6	1.8	3.5	0.0	3.4	1.9
45	26.5	23.8	21.9	6.3	3.1	1.4	2.0	1.4	1.4	2.0	3.8	0.0	3.4	1.9
46	33.3	30.0	28.1	7.9	4.0	1.8	2.6	1.8	2.0	2.8	4.7	0.0	4.2	2.6
47	36.2	32.4	30.1	9.1	4.5	2.0	3.1	2.0	2.0	2.8	5.0	0.0	4.9	2.8
48	32.5	27.0	24.9	7.1	4.0	1.6	2.6	1.6	1.6	2.4	4.2	0.0	4.0	2.5
49	29.5	26.5	24.6	7.1	3.8	1.6	2.4	1.7	1.4	2.2	4.2	0.0	3.8	2.2
50	30.2	26.2	24.0	6.9	3.7	1.4	2.5	1.8	1.8	2.4	4.4	0.0	4.0	2.3
51	27.1	24.6	22.9	6.7	3.5	1.3	2.3	1.6	1.4	1.9	3.8	0.0	3.7	2.2
52	26.0	24.3	22.5	6.7	3.3	1.6	2.0	1.6	1.8	2.4	4.0	0.0	3.5	1.9
53	25.9	24.0	22.2	6.7	3.3	1.4	2.3	1.6	1.4	2.0	3.6	0.0	2.0	4.1
54	23.7	21.4	19.5	5.4	2.7	1.3	1.7	1.2	1.2	1.6	3.6	0.0	2.9	1.6
55	28.2	21.8	20.0	5.7	3.0	1.3	2.0	1.3	1.3	1.6	3.7	0.0	3.2	1.8
56	27.7	25.1	23.1	6.8	3.3	1.7	2.2	1.6	1.4	2.0	3.8	0.0	3.6	2.0

Yellowstone River
percent of standard length

row	HLP	SNTLP	MWP	SNTOU	MTHI	INBR	OUTBR	CAUDP	GIRTH	SNTMT	SNTBR
1	28.1	15.3	7.3	10.4	6.6	6.9	9.4	17.4	34.7	15.6	9.0
2	28.6	15.9	7.2	10.3	6.2	5.2	8.3	14.5	35.2	15.5	9.7
3	30.2	17.5	7.4	9.8	6.7	6.7	8.4	14.7	34.0	16.1	9.1
4	28.7	16.3	6.8	9.1	6.5	6.5	8.1	16.3	35.2	14.7	8.5
5	29.0	16.1	7.9	10.8	6.5	6.8	9.7	15.1	35.5	15.8	9.7
6	30.3	17.2	7.8	10.2	7.0	5.3	7.8	13.5	34.4	16.0	9.8
7	29.3	15.3	7.7	9.1	6.3	7.0	11.1	14.6	36.9	15.7	8.7
8	28.7	16.1	7.3	10.0	6.1	5.4	8.0	16.1	33.7	14.9	9.2
9	30.0	16.4	7.2	9.6	6.5	6.5	9.2	15.7	32.8	15.4	9.2
10	27.4	14.0	7.2	8.5	6.2	6.5	8.5	15.6	35.2	14.3	7.8
11	28.5	14.9	7.5	9.5	6.1	6.1	8.1	15.6	34.9	15.3	8.5
12	29.1	15.9	6.9	9.7	6.2	6.2	9.3	14.9	31.1	15.9	9.7
13	29.1	16.4	7.5	10.1	6.0	6.7	9.3	14.9	34.3	16.0	9.7
14	28.0	14.9	7.1	8.5	6.4	5.7	7.4	14.9	31.2	14.9	7.8
15	27.9	15.8	7.5	10.4	5.8	5.8	7.5	17.5	32.5	15.0	9.2
16	29.0	15.6	7.4	10.0	6.7	5.6	8.2	14.5	37.9	15.6	9.3
17	29.4	16.1	7.3	10.9	5.6	6.5	8.1	14.9	32.7	15.7	9.7
18	27.8	13.9	7.5	8.9	5.7	5.7	8.5	15.3	35.2	13.9	7.8
19	31.5	18.0	8.3	11.8	6.6	6.2	7.6	13.8	35.6	17.6	11.4
20	29.1	15.1	7.8	10.1	5.8	5.8	9.3	15.5	35.7	14.7	8.5
21	29.9	15.9	7.7	10.0	5.9	5.9	8.1	16.6	34.7	15.5	7.4
22	27.3	14.9	6.2	9.1	5.4	5.8	7.9	18.2	33.5	14.0	8.3
23	28.6	15.0	6.8	9.4	6.0	5.6	7.9	14.3	34.6	14.3	8.3
24	28.6	15.8	6.6	10.0	5.4	6.2	7.9	17.4	31.1	15.4	10.0
25	29.4	15.9	7.8	9.8	5.7	5.7	8.2	15.5	34.3	15.1	9.8
26	30.7	17.1	7.8	10.5	5.8	5.8	8.2	14.4	36.2	16.3	10.1
27	29.8	15.4	8.3	9.6	6.1	6.7	8.0	14.4	36.9	15.7	9.6
28	25.9	13.7	7.2	9.1	5.7	7.2	8.4	17.1	32.7	14.4	8.4
29	28.5	14.8	8.5	8.5	5.2	5.2	7.9	14.4	37.4	14.8	7.9
30	26.7	16.1	8.5	10.2	6.4	5.9	7.6	14.4	31.4	16.1	10.2
31	28.6	14.6	7.6	9.5	6.3	6.3	8.6	13.3	32.4	14.6	8.3
32	27.6	16.1	8.6	8.9	6.9	6.6	8.9	15.1	34.5	14.8	7.9
33	28.3	16.0	7.8	9.7	6.7	5.6	8.2	14.5	33.8	15.6	10.0
34	25.8	14.6	6.0	9.3	6.0	5.3	7.9	17.9	28.5	13.9	8.6
35	28.8	16.6	8.3	9.9	6.3	6.3	8.6	15.2	31.8	16.2	9.9
36	27.6	14.2	8.2	8.2	5.6	5.2	9.0	13.8	32.8	14.2	7.5
37	29.8	15.9	8.6	9.8	7.3	6.1	8.6	14.7	34.3	17.1	9.8
38	27.8	14.8	7.7	8.5	6.7	6.3	8.8	16.9	31.0	14.8	7.7
39	27.9	14.7	8.0	8.7	6.4	6.7	9.6	16.0	32.7	15.4	8.3
40	29.4	14.9	9.1	9.1	6.8	6.5	8.7	14.2	34.3	14.6	8.1
41	28.6	14.8	6.4	10.6	6.7	6.7	8.8	17.0	0.0	16.6	9.2
42	27.4	13.5	6.0	8.8	6.5	6.0	7.9	17.2	0.0	14.4	8.4
43	26.9	14.5	5.6	9.6	6.8	6.4	7.6	19.3	0.0	14.9	8.8
44	29.0	15.0	6.1	10.3	6.5	7.5	8.4	16.4	0.0	15.9	8.9
45	28.8	14.2	6.4	9.1	6.4	6.4	9.1	17.4	0.0	15.5	8.7
46	28.1	14.2	6.4	9.3	6.4	7.1	10.0	16.7	0.0	14.9	9.3
47	30.2	15.0	6.6	10.3	6.6	6.6	9.3	16.6	0.0	16.3	9.3
48	28.5	16.1	6.4	10.4	6.4	6.4	9.6	16.9	0.0	16.1	10.0
49	28.9	15.4	6.5	9.8	6.9	5.7	8.9	17.1	0.0	15.4	8.9
50	28.8	15.4	5.8	10.4	7.5	7.5	10.0	18.3	0.0	16.7	9.6
51	29.3	15.3	5.7	10.0	7.0	6.1	8.3	16.6	0.0	16.2	9.6
52	29.8	14.7	7.1	8.9	7.1	8.0	10.7	17.8	0.0	15.6	8.4
53	30.2	14.9	6.3	10.4	7.2	6.3	9.0	16.2	0.0	9.0	18.5
54	27.7	13.8	6.7	8.7	6.2	6.2	8.2	18.5	0.0	14.9	8.2
55	28.5	15.0	6.5	10.0	6.5	6.5	8.0	18.5	0.0	16.0	9.0
56	29.4	14.3	7.4	9.5	6.9	6.1	8.7	16.5	0.0	15.6	8.7

Missouri River
percent of standard length

row	HLP	SNTLP	MWP	SNTOU	MTHI	INBR	OUTBR	CAUDP	GIRTH	SNTMT	SNTBR
1	27.6	15.2	9.9	9.9	5.3	6.2	8.2	18.5	28.0	14.8	0.0
2	29.5	15.2	9.8	9.8	6.1	5.7	7.8	15.6	29.9	15.2	0.0
3	27.5	14.4	5.2	8.7	5.7	6.1	7.9	15.7	31.4	14.4	0.0
4	28.6	16.8	10.1	10.9	5.9	6.7	7.6	21.0	35.3	16.0	0.0
5	27.8	14.6	7.9	8.6	5.3	6.6	7.9	21.2	33.1	13.9	0.0
6	28.5	15.0	9.5	8.7	6.3	5.5	8.3	17.0	33.6	15.0	0.0
7	28.7	16.0	8.7	9.1	6.5	6.5	8.7	13.8	34.9	15.3	0.0
8	28.4	15.2	5.9	9.3	5.9	9.3	9.3	16.2	28.4	15.2	0.0
9	26.2	14.2	8.5	9.9	6.4	5.7	8.5	19.9	31.9	17.0	0.0
10	34.1	16.1	8.8	9.2	6.6	6.6	8.8	15.4	34.4	16.1	0.0
11	30.0	16.3	5.3	10.6	6.2	6.2	8.4	14.5	35.2	15.9	0.0
12	30.0	15.5	10.3	9.0	6.0	6.0	8.2	17.2	33.5	15.5	8.6
13	30.2	15.5	5.2	10.3	6.0	3.4	6.9	14.2	28.4	15.9	9.1
14	28.1	16.1	5.4	9.8	5.8	5.4	8.5	17.0	31.3	14.7	8.9
15	29.4	15.3	5.1	9.4	6.0	5.5	7.7	15.3	28.9	14.5	8.9
16	29.7	15.8	5.7	10.0	6.2	5.7	9.1	18.2	34.9	15.8	9.6
17	29.2	15.0	5.3	8.8	6.2	6.2	8.4	16.4	31.9	14.6	8.0
18	29.4	16.1	5.7	10.0	6.6	6.6	9.0	16.1	31.3	15.6	9.0
19	28.8	16.2	5.4	9.9	6.3	6.3	8.1	17.1	31.1	15.3	9.5
20	30.0	16.0	6.0	9.5	6.5	7.0	9.0	15.0	33.0	15.0	9.0
21	28.2	15.9	6.2	9.7	6.7	6.2	7.7	18.5	34.9	15.4	8.2
22	28.0	15.0	5.6	8.9	6.1	6.1	8.4	16.8	31.8	14.5	8.4
23	28.8	14.9	5.8	9.1	5.8	6.3	8.7	17.8	33.2	14.9	8.7
24	28.6	15.8	5.9	9.9	5.9	5.9	7.9	18.2	35.5	15.3	9.4
25	29.6	15.2	4.8	9.6	5.6	6.0	8.0	15.6	31.6	14.8	8.4
26	30.0	15.0	4.7	9.9	5.9	5.9	8.3	17.4	32.0	14.2	8.7
27	30.3	16.2	5.0	9.1	5.8	6.6	9.1	15.4	33.6	14.9	9.1
28	28.3	15.2	5.1	10.1	5.5	5.5	7.6	17.7	32.9	14.3	8.9
29	29.0	16.4	5.8	10.6	7.2	7.7	9.2	19.3	32.9	15.5	9.2
30	29.8	17.3	6.3	11.0	7.3	5.8	6.8	15.7	35.1	16.8	8.9
31	28.4	15.9	5.8	8.7	6.3	6.7	7.2	18.3	30.8	14.4	7.7
32	28.9	16.0	6.4	9.6	5.9	4.8	8.0	19.3	35.3	15.0	8.6
33	29.0	15.7	5.7	10.0	7.1	6.2	8.1	18.1	31.0	15.2	8.6
34	29.6	16.5	10.4	10.4	6.1	6.5	9.6	16.5	34.8	14.8	9.1
35	28.6	15.4	5.0	9.1	5.8	6.2	8.3	16.6	33.2	14.1	8.3
36	29.1	15.7	9.0	9.7	6.7	6.0	9.3	18.3	34.3	14.9	9.0
37	29.4	15.7	5.9	9.8	6.4	7.4	10.3	18.1	36.3	15.2	7.8
38	29.8	16.2	9.1	9.8	6.8	6.8	8.3	16.2	35.5	15.1	8.3
39	28.5	15.3	4.4	9.5	5.5	6.6	8.8	15.7	34.3	14.6	9.1
40	29.0	16.4	7.6	10.1	6.0	6.6	8.5	14.5	36.0	15.8	9.5
41	29.8	15.5	7.1	10.1	6.7	5.5	8.4	15.1	0.0	16.0	9.2
42	26.8	13.4	6.1	8.2	5.6	5.6	7.4	17.3	29.4	13.4	7.8
43	27.7	13.6	6.8	9.8	6.0	6.0	9.4	17.9	29.8	14.9	9.4
44	28.4	14.7	6.9	9.9	6.0	6.9	9.5	17.7	31.0	15.1	8.6
45	27.7	13.8	5.8	9.8	5.4	5.8	7.6	17.0	32.1	15.2	8.5
46	30.7	16.0	6.9	11.0	6.9	6.9	8.2	15.0	35.1	15.7	9.1
47	31.9	16.9	8.9	10.5	6.5	7.3	9.3	17.3	35.9	16.5	10.1
48	28.5	15.0	5.8	10.6	6.8	6.3	8.7	18.4	32.4	15.5	9.2
49	28.8	15.1	6.4	9.1	5.9	6.4	9.1	15.5	33.8	14.6	8.2
50	30.0	15.4	6.5	10.0	6.9	6.5	8.8	16.5	33.8	15.4	8.8
51	28.5	14.9	5.8	9.9	6.6	5.8	7.9	16.5	31.8	15.7	9.5
52	29.1	14.6	8.9	9.7	6.5	6.5	9.3	17.4	33.2	15.0	8.9
53	27.4	13.1	5.9	9.3	5.9	6.8	9.3	19.4	19.4	14.8	8.0
54	26.0	13.7	5.9	9.8	6.4	6.4	8.8	20.1	29.9	15.2	8.8
55	27.9	15.4	6.7	10.6	5.8	6.7	9.6	23.1	0.0	16.3	9.6
56	28.0	13.3	5.8	8.4	6.2	5.3	7.6	16.9	0.0	14.2	8.0
57	29.6	15.6	6.4	10.0	6.8	6.4	8.8	16.0	0.0	16.0	9.6

row	HLP	SNTLP	MWP	SNTOU	MTHI	INBR	OUTBR	CAUDP	GIRTH	SNTMT	SNTBR
58	28.5	15.1	5.9	10.0	6.7	5.9	7.5	15.9	0.0	15.9	9.6
59	28.6	14.8	6.2	9.5	6.7	6.2	8.1	18.1	0.0	16.2	9.0
60	29.9	14.3	6.6	9.4	7.4	7.4	10.2	16.4	0.0	15.6	9.0
61	27.8	13.9	6.4	9.4	6.4	6.8	9.4	17.3	0.0	15.0	8.6
62	28.6	14.8	6.6	10.2	7.2	6.6	9.5	14.5	0.0	16.1	9.2
63	29.0	15.3	6.7	11.0	6.3	6.3	9.4	16.1	0.0	16.5	10.2
64	28.3	15.0	6.4	10.4	6.9	6.9	9.8	18.5	0.0	16.2	9.2
65	31.4	15.9	6.4	11.3	8.1	6.7	8.8	15.5	0.0	17.0	9.9
66	32.3	13.9	6.8	9.0	6.8	6.0	8.3	16.5	0.0	15.0	8.3
67	30.0	15.8	6.9	10.5	6.9	6.5	8.9	17.0	0.0	16.2	9.7
68	28.3	15.1	6.3	10.7	6.3	7.8	8.8	17.1	0.0	15.6	9.3
69	29.7	15.6	6.8	10.4	7.3	6.3	7.3	18.8	0.0	16.1	9.4
70	30.2	16.4	6.9	10.8	6.9	6.0	7.8	15.1	0.0	16.4	9.5
71	27.4	13.5	6.3	9.0	7.2	7.2	9.0	17.0	0.0	15.2	7.6
72	27.4	14.2	6.1	9.4	7.5	6.6	8.5	17.5	0.0	15.1	8.5
73	29.9	14.9	6.3	10.0	6.3	5.9	8.1	18.1	0.0	16.3	9.0
74	29.4	14.4	5.9	9.6	7.0	7.0	9.1	16.6	0.0	16.0	9.1
75	30.9	16.5	7.0	10.5	7.7	6.7	9.1	16.1	0.0	17.2	9.8
76	30.5	15.9	6.2	10.6	7.1	7.1	9.7	16.8	0.0	16.4	9.7
77	30.6	15.6	6.8	10.2	6.5	7.8	10.2	15.0	0.0	16.3	9.9
78	30.2	15.1	6.1	10.4	6.6	6.1	8.5	16.5	0.0	16.0	9.0
79	29.5	15.3	6.3	10.0	7.4	6.8	8.9	16.8	0.0	15.8	8.9
80	29.2	16.1	5.8	12.4	7.3	5.8	8.0	22.6	0.0	17.5	10.2
81	28.7	15.6	5.9	10.1	6.8	6.8	9.3	18.6	0.0	15.6	8.4